Chemistry Quiz
Equilibrium
Instructor's Version B

Answer Sheet

1.	D
2.	A
3.	B
4.	E
5.	C
6.	E
7.	A
8.	A
9.	E
10.	E

© Copyright 2002 Apex Learning Inc. All rights reserved. This material is intended for the exclusive use of registered users only. No portion of these materials may be reproduced or redistributed in any form without the express written permission of Apex Learning Inc.

Free-Response Questions

Time Limit: You have 30 minutes to complete this section.
Scoring: 60 points total; each question is worth 30 points; points for each section are indicated within the questions.
Calculator Use: You may use a calculator on both questions.

1. **Ammonium carbamate decomposes according to the following equation:**

   $NH_4CO_2NH_2$ (s) ⇔ $2NH_3$ (g) + CO_2 (g) ($\Delta H < 0$)

   A sample of the solid reactant is heated to 40°C, allowed to decompose and come into equilibrium with the products.

   A. Write the equilibrium expression for Kp. (5 points)

   $K_p = P_{NH3}^2 * P_{CO2}$

   B. If the equilibrium pressure of the CO_2 = 0.121 atm, what is K_p? (10 points)

   2 moles of NH_3 form for every 1 mole of CO_2. This means twice the pressure for NH_3.

   $K_p = (0.242)^2(0.121) = 0.00709$

   C. What conditions of Temperature, Pressure, and Volume would optimize the production of ammonia and carbon dioxide? Explain your choices. (15 points)

   Low temperature, low pressure, high volume.

© Copyright 2002 Apex Learning Inc. All rights reserved. This material is intended for the exclusive use of registered users only. No portion of these materials may be reproduced or redistributed in any form without the express written permission of Apex Learning Inc.

The solubility equilibrium equation for barium sulfate is:

$$\mathbf{BaSO_4\ (s) \Leftrightarrow Ba^{2+}\ (aq) + SO_4^{2-}\ (aq)}$$

A. Write an expression for the solubility product constant, K_{sp} for this reaction. (5 points)

$K_{sp} = [Ba^+][SO_4^{2-}]$

B. If the $K_{sp} = 1.1 \times 10^{-10}$ at 25°C, what is the maximum concentration of $BaSO_4$ (aq) at this temperature? (10 points)

$K_{sp} = [Ba^+][SO_4^{2-}]$ Since the two ions form in a 1:1 ratio, their final concentrations are equal.

$1.1 \times 10^{-10} = (x)(x)$ $x = 1.0 \times 10^{-5}$ M = $[Ba^+] = [SO_4^{2-}]$

C. What effect would adding solid Na_2SO_4 have on the concentration of Ba^{2+} ions? Explain. (5 points)

Na_2SO_4 would dissociate in the water, forming free sodium and sulfate ions. The sulfate ions would act as a common ion in the equilibrium between the barium sulfate and its ions. The effect would be to push the equilibrium back towards the reactant, decreasing the concentration of Ba^{2+}.

© Copyright 2002 Apex Learning Inc. All rights reserved. This material is intended for the exclusive use of registered users only. No portion of these materials may be reproduced or redistributed in any form without the express written permission of Apex Learning Inc.

D. Calculate the concentration of Ba^{2+} ions if solid $BaSO_4$ is added to a 0.001 M solution of Na_2SO_4. (10 points)

$$BaSO_4\ (s) \Leftrightarrow Ba^{2+}\ (aq) + SO_4^{2-}\ (aq)$$

Initial	---	0	0.001 M
Change	---	+x	+x
Equilibrium	---	x	0.001 + x

$1.1 \times 10^{-10} = (x)(0.001 + x)$

$x = 1.1 \times 10^{-7}$ M $= [Ba^{+}]$

© Copyright 2002 Apex Learning Inc. All rights reserved. This material is intended for the exclusive use of registered users only. No portion of these materials may be reproduced or redistributed in any form without the express written permission of Apex Learning Inc.